

Attorney Docket #: N1085-00018(TSMC2002-0629)
Application Serial No.: 10/730,533
TC/AU No.: 1756
Amendment dated —

REMARKS

This reply is responsive to the office action mailed October 13, 2006 ("Office Action"). Claims 1, 9, 10, and 16 have been amended to place the claims in better condition for allowance or appeal. Claims 1, 3-7, and 9-16 remain pending in the application. Several objections and rejections to the specification and claims are raised in the Office Action. These have been fully addressed by this response and are discussed in turn below. No new matter is added.

SPECIFICATION

The present amendment includes amendments to the title, abstract, and specification as requested by the Examiner to address minor informalities noted in the Office Action on pages 3-6 and place the application in condition for allowance. Accordingly, Applicants respectfully request withdrawal of the objections to the specification.

CLAIM OBJECTIONS

Claims 9-16 are objected to because of informalities on page 6 of the Office Action. These claims have been amended as required to address and overcome the noted informalities. Accordingly, Applicants respectfully request the claim objections be withdrawn.

CLAIMS REJECTIONS

Rejections under 35 U.S.C. § 112:

Claim 1 has been amended without disclaimer to remove the reference to "substantially" in order to expedite prosecution and allowance of the present case. This amendment addresses the rejection under 35 U.S.C. 112, first paragraph of claims 1 and 3-7 on page 7 of the Office Action. Accordingly, Applicants respectfully request the claim rejection be withdrawn.

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Claims 9-16 stand rejected under 35 U.S.C. 112, second paragraph for lack of antecedent basis in claims 9 and 10 for the phrase "said semiconductor substrate...." These claims have been amended to address these rejections. Accordingly, Applicants respectfully request the claim rejections be withdrawn.

Rejections under 35 U.S.C. § 102(e) and § 103(a):

Claims 1 and 3-7 stand rejected as anticipated by or, in the alternative, obvious under 35 U.S.C. 103(a) as over U.S. Patent Application Publication 2004/0101765 to Sivakumar et al. ("Sivakumar"). Claim 1 is independent and claims 3-7 depend directly or indirectly from claim 1. This rejection is respectfully traversed for the reasons presented below, and the same reasons presented in the last amendment filed by the Applicant on June 26, 2006, which remain applicable and are incorporated herein by reference. The anticipatory and obviousness rejections are discussed jointly below.

Independent claim requires *inter alia* "at least one annular equal line space phase shifting pattern on said mask substrate to produce an unexposed region on a semiconductor substrate ... including: an annular ring, and a central portion, wherein a mask pitch of said at least one annular equal line space phase shifting pattern is smaller than two times of a corresponding critical dimension pitch on said semiconductor substrate." The underlined limitations are not taught or fairly suggested by Sivakumar.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim."

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Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

“To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.02 (citing *In re Royka*, 490 F.2d 981 (CCPA 74)). Furthermore, “[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art.” MPEP 2143.02 (citing *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970)).

Sivakumar does not teach or suggest a phase shifting mask pattern comprised of annular equally-spaced lines for forming large unexposed areas on a semiconductor substrate. The only reference in Sivakumar to any type of annular phase shifting pattern for a lithographic mask is arguably found in FIG. 6D, which is characterized as a “sort of ‘bulls eye’ configuration, wherein a single square 604 is formed within a phase shifted closed perimeter 606 separated by a non-phase-shifted area 608.” (Sivakumar, col. 3, para. 0029.) Sivakumar makes no further elaboration on FIG. 6D or annular line patterns on masks whatsoever. And significantly, Sivakumar also clearly does not characterize the annular “bulls eye” configuration as necessarily being equal spaced or quantify any definitive line spacing requirements specifically related to the annular pattern. In contrast, Applicant fully discloses that the annular mask pattern is made of equal spaced lines or phase edges, the significance of the annular equal line spaced phase shifting mask patterns for forming large unexposed areas on a semiconductor substrate, and the relationship of mask pitch (Pm) to critical pitch (Pcs) on the semiconductor substrate for determining the number of annular lines required for a given unexposed area size on the substrate. (*see, e.g.*, paras. 0020-0025). Sivakumar, however, is completely silent on these issues. Accordingly, Sivakumar neither discusses equal line spacing nor arguably provides an

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enabling disclosure with respect to annular equal line spaced mask phase shifting patterns. Moreover, considering Applicant's invention as a whole as is required, Sivakumar thus neither recognizes nor appreciates the significance of annular equal line spaced mask patterns or how to use such a pattern in forming phase shift masks. *See* MPEP 2141.02 ("In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious." (citing *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530 (Fed. Cir. 1983))). For at least these reasons, Sivakumar does not anticipate or render obvious claim 1 and claims 3-7 depending therefrom.

In light of the foregoing and for the same reasons, it is not surprising that Sivakumar also then does not teach or suggest making the mask pitch (P_m) less than "two times of a corresponding critical dimension pitch on said semiconductor substrate" to prevent the formation of multiple elements on the semiconductor substrate in lieu of a desired single large unexposed area. In fact, Sivakumar is silent on any correlation between mask pitch (P_m) for annular equal line spacing and critical dimension pitch (P_{cs}) on the semiconductor substrate. Thus Sivakumar leaves one skilled in the art with little or virtually no guidance in determining an appropriate mask pitch other than a vague remark that "[i]f the phase-shifting features are small enough and close enough, the corresponding composite aerial image produced by projecting the phase-shifted and non-phase-shifted light will merge to provide sufficient exposure to pattern a large area in a resist layer." (Sivakumar, para. 0027; *see also* para. 0030 (similar)) Accordingly, unlike Applicant's foregoing underlined formula and guidance, Sivakumar leaves one skilled in the art with this imprecise explanation and apparent trial and error to determine any suitable

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spacing or pitch P_m between phase edges on the mask. For these additional foregoing reasons, Sivakumar does not anticipate or render obvious claim 1 and claims 3-7 depending therefrom.

In support of the rejection of claims 1 and 3-7, the Office Action relies on two unrelated numerical references in Sivakumar, and then proceeds to improperly use the Applicant's own disclosure against the Applicant with respect to the foregoing underlined limitations of claim 1 in an attempt to show that Sivakumar discloses or renders obvious all of the claim limitations. On page 9 of the Office Action, reference is made first to the Background section in Sivakumar (para. 0004) which discloses a 0.1 microns (100 nm) in the prior art as corresponding to an "ideal case" for the width of a feature or phase edge separation on the mask. Sivakumar discloses that if this width or edge spacing is increased to as little as 200 nm in an attempt to create a large unexposed region on the semiconductor substrate, two narrow lines would be created and resolved on the substrate instead the desired larger area. (See Sivakumar, para. 0004.)

Accordingly, one skilled in the art is taught that 100 nm is the maximum workable width of a mask feature or phase edge that can be used to create an element on the semiconductor substrate with a corresponding width. The Office Action next assumes equal line spacing on the mask, which is not disclosed at all by Sivakumar, and transposes the 100 nm width to a mask pitch (P_m) of 200 nm. Even assuming *arguendo* equal line mask spacing, Sivakumar thus apparently teaches that this mask pitch (P_m) would be a maximum desirable mask pitch, not a pitch determined by Applicant's claimed guideline of two times of a corresponding critical dimension pitch on said semiconductor substrate that might exceed 200 nm depending on the critical pitch.

The Office Action next takes an unrelated reference from Sivakumar which merely discloses that a modern IC may have many lines each having an exemplary base width of .25

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microns (250 nm), which corresponds to the limitation of the photolithography technology (at the time Sivakumar was filed). (Sivakumar, para. 0025.) This is then correlated in the Office Action to an assumed critical pitch (Pcs) of 500 nm. (Office Action, page 9.) Using Applicant's own teaching against the Applicant, the Office Action then uses the two entirely unrelated numerical references from Sivakumar (*i.e.*, 100 nm maximum photomask feature width and 250 nm exemplary substrate element base) and applies the Applicant's underlined limitation of claim 1 for determining mask pitch Pm (*i.e.*, mask pitch of said at least one annular equal line space phase shifting pattern is smaller than two times of a corresponding critical dimension pitch on said semiconductor substrate) to argue that Sivakumar discloses the underlined claimed limitation.

In sum, because Sivakumar does not disclose the foregoing underlined limitation nor annular equal line spacing, the Office Action relies on circular reasoning impermissibly using hindsight in rejecting Applicant's claimed invention. *See Interconnect Planning Corp. v. Feil*, 774 F.2d 1132 (Fed. Cir. 1985)(It is error to reconstruct the patentee's claimed invention from the prior art by using the patentee's claim as a blueprint.). Moreover, considering Applicant's claimed invention as a whole, one skilled in the art is given positive and clear guidance that if annular equal line spacing phase shifting pattern disclosed only by the Applicant is used, the mask pitch Pm has to be smaller than two times of a corresponding critical dimension pitch on said semiconductor substrate in order to form a large unexposed dark region on a semiconductor substrate. (Applicant's disclosure, para. 0024.) Conversely, as discussed above, Sivakumar provides only vague direction on mask pitch Pm saying that phase-shifting features should be "small enough and close enough ... to pattern a large area in a resist layer [on a semiconductor

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substrate].” (Sivakumar, para. 0027.) Indeed, under Sivakumar’s disclosure that the maximum line width on a photo mask should be 100 nm, one skilled in the art would be taught that “close enough” means a mask pitch (Pm) of no more than 200 nm, not “smaller than two times of a corresponding critical dimension pitch on said semiconductor substrate” as claimed by the Applicant. Accordingly, for these additional reasons, it is further respectfully submitted that the rejection of claim 1 and 3-7 depending therefrom as being either anticipated by or obvious in view of Sivakumar is not supported by the evidence. Accordingly, reconsideration and allowance of claims 1 and 3-7 is respectfully requested.

Claims 9-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sivakumar in view of either United States Patent 5,302,477 to Dao *et al.* or United States Patent Publication 2003/0027057 to Schroeder *et al.* Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sivakumar in view of United States Patent 5,240,796 to Lee *et al.* Claims 9 and 10 are independent. Claims 11-16 depend from claim 10.

Independent claims 9 and 10 are similar to claim 1, in that each also requires “at least one annular equal line space phase shifting pattern... wherein a mask pitch of said at least one annular equal line space phase shifting pattern is smaller than two times of a corresponding critical dimension pitch on said semiconductor substrate.” For at least the reasons presented above with respect to the discussion of claim 1, the primary reference Sivakumar relied upon in the Office Action does not teach or suggest either of the underlined limitations. Accordingly, claims 9 and 10 are not obvious. “To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.02 (citing *In re Royka*, 490 F.2d 981 (CCPA 74)). Claims 11-16 are not obvious for at least the same reasons as claim 10

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from which they depend, and in view of the additional limitations added by these claims which further distinguish over the cited references. Reconsideration and allowance of claims 9-16 is respectfully requested.


CONCLUSION

In view of the foregoing, Applicant respectfully requests entry of the amendments herein which are believed to place the claims and application in condition for allowance.

Reconsideration and allowance of all pending claims is thus requested. If the Examiner disagrees with the allowability of the claims or if there are any remaining issues that may be resolved by telephone to expedite allowance, the Examiner is kindly requested to contact the Applicant's undersigned representative at 215.979.1554.

Respectfully submitted,

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